Beijing Parking Issue

A Case Study in Lama Temple Area

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By

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Abstract:

Beijing Old City was built hundreds of years ago. The structure of Beijing Old City was not designed for automobiles. And today, Beijing Old City is unable to meet the needs of current traffic conditions. With the increase in car ownership in Beijing, parking is a serious problem of the city, especially for Beijing Old City. Government has established a number of policies and solutions for parking in Beijing Old City. But the result is not satisfactory because government may not fundamentally understand the cause of parking problem in Beijing Old City. By doing a case study of a historical preservation district in Beijing Old City, the paper tries to find out the major problem of parking in the area, and find out the root cause of the problem in the study area. The paper includes a review of literatures that related to parking issues. Based on different literatures, and site observation, I make a hypothesis on major parking problems in the study area. The methodology part introduces how to prove my hypothesis, and explains my data collecting methods. By calculating the usage rate of parking facilities, and combining with parking price analysis, I make a comprehensive conclusion of parking problems in the study area. The paper also includes a data collection methodologies; a discussion on current and future policies of parking regulations in Beijing. And in the end, some possible solutions for parking in the study area are presented.

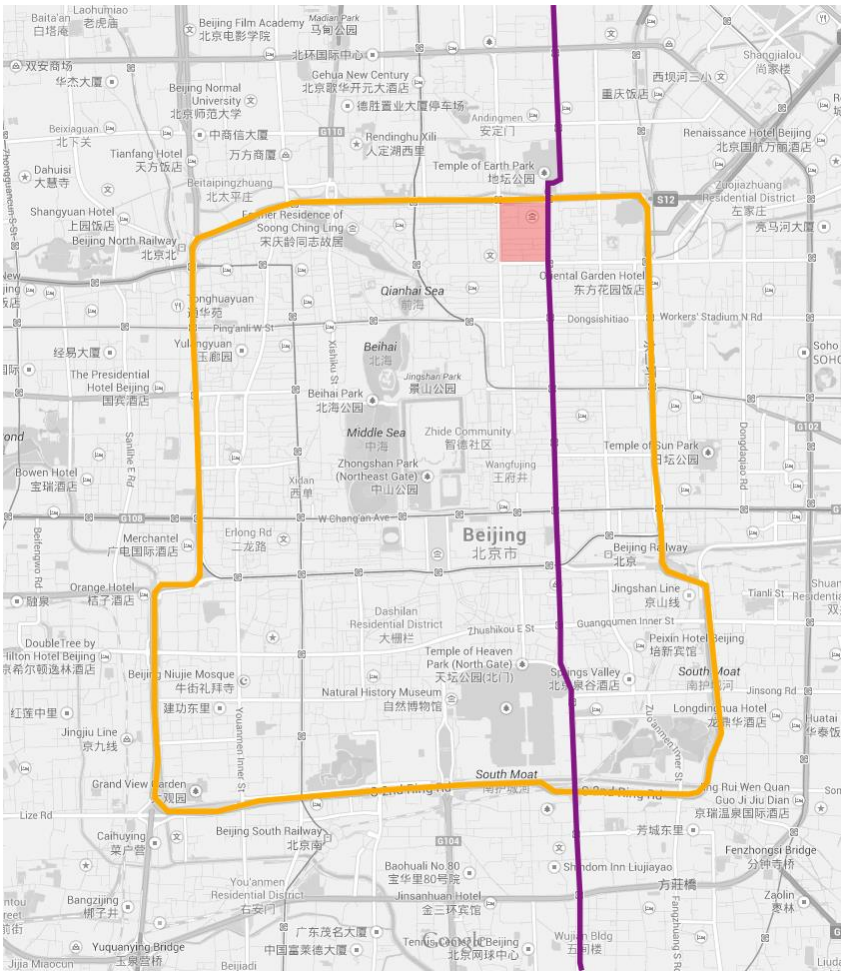
Introduction:

Beijing has a history of more than one thousand years where the original urban planning, transportation planning won't suitable for today's traffic situation. Beijing city wall was torn down in 1960s. Meantime, the 2nd Ring Road was started to construct. After three decades, the 3rd Ring Road was constructed. Only 15 years later, by the end of year 2009, the 6th Ring Road was open to traffic. And the 7th Ring Road is expected to open to traffic in 2015 (out of the city boundary).

Here is a whole picture of Beijing's car ownership. In 1997, Beijing has one million registered vehicles. The number jumped to two millions after six years and two months. And then, after four years and two months, in 2007, the number jumped to three million. And the four millionth car registered in Beijing in 2009. It only took two years and seven months from three million to four million. And it only took 2 years and 2 months from four million to five million. The latest data shows that by Oct. 2013, Beijing has more than 5.4 million registered vehicles. What a rapid growth. If we calculate the rate of ownership, every ten people owned one car in 2002. And by 2012, every ten people owned 2.6 cars. Removing the factor of population growth (since population growth is also rapid in the last decade), the rate of car ownership is still more than doubled.

Meantime, China experienced its first car boom in the past two decades. In this paper, I will focus specifically on parking issue to investigate the development, current situations, major problems and the future trend of parking in the study area in Beijing, China. The reason why I'm interested in this topic is because that it is a planning issue that solves real problem. It gains a lot of social benefit and promotes city's long term sustainable development strategy. At the end of the paper, I will provide some possible solutions for parking in Beijing Old City. And try to work out a sustainable way of parking development strategy for the defined area, and Old City in Beijing.

The study area I defined is Lama Temple area, which located within the north second ring road and right next to the subway line 5. Map 1 shows the location of the study area on Beijing city map. The yellow line represents the 2nd Ring Road, and the purple line represents the Subway Line 5. More precisely, the area I defined is north to the south of the North 2nd Ring Road; South to the north of East Jiao Dao Kou Street; West to the east of An Ding Men Nei Street; East to the west of Yong He Gong Street. The defined area is within the above mentioned four major boulevards. And within the defined area, there are totally eight one way roads and several dead end narrow alleys. All roads within the four major boulevards are called Hutong in Chinese. The reason why I decide to choose this area as the study area is because of following reasons. First, this parcel of land in Beijing is one of twenty five historical preservation areas in Beijing Old City. Next, within the defined area, there are residential buildings, office buildings, commercials, historical sites, schools, hospitals, government departments, state-owned companies, and museums, etc. This area is rich in content, and it is representative enough of Beijing Old City. And the most important is that parking is a serious problem in the area.



Map 1: The Study Area is under Red Shadow

However, since there are many things related to parking issues, what is the major problem in the defined area? Since the study area is in Beijing Old City, the area has a history of more than 700 hundred years. The area was designed to serve pedestrians, maybe some traditional transports

like carriage, but not for automobiles. So the lack of parking spaces is a major problem. But only increase parking spaces is not the solution. On the contrary, it will worsen the problem, because more parking spaces mean easier access to the area, which could result to more traffic congestion. Since the area could provide limited parking spaces, even some increases in parking spaces, could not catch up with people's parking demand. Then, what could be the major issue in this area? In the area, there are lots of historical buildings, so it will be difficult to implement some advanced parking facilities. Underground parking will damage historical value of the area. And multi-story parking structures will have a risk of damage historical buildings also. So from the technical point of view, the area is not suitable to be implemented advance parking facilities. And then, by retaining the existing parking facilities and volume, what else can be emphasized on parking issue in the area? The answer is parking price and law enforcement. The better parking management in the study are could make parking price more reasonable and strengthen law enforcement.

Literature Review:

Since I hypothesize parking is underpriced in Beijing old city, I reviewed some articles that analyze parking fee's effect on people's travel behavior specifically in downtown Beijing. And my defined area is also considered as part of downtown area in Beijing. So the result of their study could be helpful to my study. Hu's *A Parking Pricing Model with Parking Behavior in City* indicates that higher parking fee could drive out cars from downtown Beijing and further change people's driving behaviors (Hu, 2011). For parking time as an example, the existing parking standard in my defined area only has two levels. One is the rate during the first hour, and the other is the rate after the first hour. However, their study creates a more sophisticated rate method. Authors dived parking hour into four category based on length of parking time. And authors also argue that the parking fee should be different by different types of travel behaviors. It is like some toll road system in America, if people travel with more than 2 people, then they won't be charged. However, if a vehicle has 2 or less than 2 people, then they should pay the toll. In the article, authors create two types of alternatives. One is travel alone (only 1 person in a car). And the other is travel by 2 or more than 2 people. These two kinds of alternatives pay different prices when they park in downtown Beijing. Besides, authors also create some other standard, like different types of parking lots should charge differently. There are totally 36 combinations. However, the existing parking standard in my study area has only 7 combinations (Li, Zhang and Papacostas, 2008).

Chen, Yang, and Xu introduce planning and design of park and ride (P&R) facilities in Beijing. The article argues that the configuration of park and ride facilities could have significant impact on traffic congestion and parking. Besides, the article also mentions that usage rate of P&R facilities is the key to success of P&R facilities. However, what determines usage rate of P&R facilities? Authors suggest that apart from physical design of P&R facilities, price is an important factor. Price of P&R facilities could affect people's travel behavior. If price is too high, a portion of drivers would choose to drive instead of park and ride, which could result to a low usage rate of P&R facilities. Then it would cause a waste of social resources. However, if price is too low, which could make full use of P&R facilities, but that would make P&R facilities meaningless, because P&R facilities is design for diversifying way of transportation. Low price would result to crowding in subways and lengthen rides' waiting time (Chen, Yang, and Xu, 2012). Another literature that written by Xiong also analyze the impact of price of parking and

ride facilities (Xiong, 2011) From these literature, I could learn the importance of setting a price for parking facilities.

MO, Zhang, and Yan did a case study of people's parking behavior in Shanghai CBD. They find that parking fee in Shanghai CBD doesn't have a significant impact on people's driving behavior. Only 23% of response said parking fee in the area will affect their travel behavior. However, travel destination and availability of parking space would significantly affect driver's travel behavior (Mo, Zhang, and Yan, 2008). The result could indicate that parking fee in Shanghai CBD is underpriced. In my paper, I will also exam how price affect people's travel behavior in Beiing old city. Another journal article talks about the floating parking charges' impact on people's parking behavior. They want to learn the acceptance of floating parking rate, to see whether it is acceptable and feasible. They obtained floating parking charges through the questionnaire forms. Generally, the result of their surveys shows that floating parking rate is feasible and it also shows that the floating parking rate could impact on people's parking choice (choose different types of parking lots) and trip mode. The survey divides parking behavior into three categories, residential parking, commute parking, and non-commute parking. It shows that all three kinds of parking behavior are sensitive to the floating charges. Based on the current parking fee, 10% responders say that they can't afford it, and they'd rather choosing public transportations. If the price were doubled, more than 65% of responders would not drive. And if the price were tripled, about 85% of responders would not to drive. This result indicates that people are strongly sensitive to floating parking rate. So it will strongly affect people's trip mode. However, a more detailed analysis shows that if the price rose between 0-60 percent, which is from the current 5 yuan to 8 yuan, it won't deter too many drivers from driving. But people will change their choice of parking lot. People used to choose to park on street may then choose to park in garages. This analysis is significant because it shows that drivers' sensitive to price change (Zheng, Chen, Ye, and Li, 2012).

A Model of Parking Choice and Behavior analyze the downtown parking policy from a new angle, a technical angle (Ji, Wang, Deng and Saphores,2008). The author is trying to use quantitative data and cost and benefit analysis to try to frame a rational downtown parking policy. However, the author doesn't simply considers from the cost and benefit perspective. He also takes some non-economic factors into consideration, such as environment, and pedestrians. He considers about the long-term development of a downtown area. "Meeting new demand without undermining the pedestrian environment may be more important to successful long-term revitalization of Downtown than an aggressive approach to providing parking." (Trenton Downtown Parking Policy) Based on his analysis, the average cost of different types of parking facilities are various. For instance, the surface parking lots' land cost per space costs about 4 times than a 4-level parking structure. However, the construction cost per space of a surface parking lot is about 7 times less than a 4- level parking structure. By his analysis, underground parking facility has the highest total annual cost. On-street parking has the lowest. Nevertheless, the result could be different depends on different cities, because the land cost could be very different. But his idea of using the cost benefit analysis is brilliant. The method could be applied to other cases (Harris, 2008).

Besides that, the author considers that more parking spaces is not always the answer to solve parking problems. "Minimum parking requirements can be excessive if they have been based on demand surveys performed in automobile-dependent locations." (Trenton Downtown Parking

Policy) That's because the demand is based on different parking fees. And then, the author argues about the benefit of on-street parking. He says that the on-street parking could provide a buffer for pedestrians, and other activities on sidewalks. However, this may not be the case in Beijing, China. Since every road has a wider bike lane. But another point does make sense, which is that the on-street parking could slow moving traffic and increase the safety factor on road. Although, the author spoke highly of on-street parking, but he also points out that the time duration of on-street parking should be limited. The longer parking should be located off-street. And that will give a downtown area a better economic benefit. From the author's point of view, the time duration of on-street parking is the most important thing, instead of parking rate. This is a significant point of view to my study, because his view is contrary to the current existing parking standard in my study area. In my study area, there is no limited parking time for on-street parking. And the first hour charges the most. That is to say, people are encouraged to park a longer time. In the author's opinion, it is a bad policy. Since on-street parking provides more conveniences to people than off-street parking facility does, people should first consider park on-street. So rates of on-street and off-street parking should be different. Policy makers could either increase the rate of on-street parking or lower the rate of off-street parking (Harris, 2008).

The lack of law enforcement is another problem of Beijing's parking issue. And Vincent Au mentions in his article *Car Parking in China – Issues and Solutions*. Too many government departments are in charging of parking related matters. They are Commission of Transport, Traffic Police, Traffic Management Bureau, Urban Management Bureau, Municipal Bureau, Street Office, Industrial and Commerce Bureau, and Price Bureau (Au, 2012). These different government departments are responsible for different functions. But many functions are related to parking. For example, traffic police are responsible for guiding the traffic, but the Traffic Management Bureau is in charging of traffic management. The Price Bureau set the price of parking ticket, and the Commission of Transport gives tickets. And then, the fine is going to the Commerce Bureau. The whole process is complicated. So if only a little miscommunication happens among these different government departments could result to a big problem in traffic law enforcement. And the truth is, it does happen. So the result is "the chaotic of management of parking creates an "obstruction for the effective formulation of car-park planning, control policy, law enforcement, etc." (Au, 2012) So, how to deal with the problem of benefit distribution among different government departments and how to remove unnecessary government departments are important tasks for planners and policymakers in China. Throughout research, I conclude that besides of lack of parking spaces there are six major problems in Beijing:

Drivers' parking behaviors

> In the 1990s, more than 90 percent of households in did not own private cars. At that time drivers could park almost everywhere for free. The local government didn't come up with an illegal parking punishment until 2000. So those early drivers in the city do not have the consciousness of parking. Today, those early drivers sometimes violate parking policy because they don't get used to the current parking policy.

Non-drivers behaviors

> A common issue of selfish behavior exists among shop owners. Some shop owners illegal occupy the street parking spaces in front of their stores. Those shop owners illegally change street parking spaces in front of their stores to non-parking or

customers only, and this phenomenon especially existing in among restaurant owners. They even let customers park on sidewalk in front of their restaurants.

Shortsighted view of planners

The lack of parking spaces not only occurs in old town/inner city but also occurs in newly development commercial/business districts. It is because of the shortsighted view of planners. Planners/developers are trying to maximize the commercial area in a mall. So a mall which requires 4 basement level of parking is usually designed to 2 basement level of parking. Developers lease the first 2 level to a supermarket to make profits.

Outdated parking management system

Zhongguancun is the I.T. center of Beijing, where has an advanced parking management system. When people drive into that area no matter from which direction, drivers could follow electronic sighs to the parking lot of the building they want to go. When people drive to a parking lot, electronic sighs could guide empty parking spaces for drivers. The up-to-date information board shows the number of open space of selected parking lots. However in most part of the city, the parking management system is outdated or no management. A worker in a parking lot writes down the time when you park on a piece of paper and put it on your windshield. That's the most common way of parking management in Beijing.

Different charge by time

The existing charging policy in the city is inefficient. There is no time limited parking on street. So nearby residents may park their car for a long time on streets even couple of days. The street parking could not provide parking spaces to people who really need them. Also, the price of parking is not based on market price. The only different is day time and night rates.

Control policy, law enforcement and punishment

Most of parking lots in Beijing were contract out to individuals. People always negotiate with manager of parking lots for a lower long-time parking rate. The Traffic Management Bureau of Beijing only issues a brief guide of parking control policy. So Beijing doesn't have detailed ordinance of parking control and punishment method. People who have good relation to traffic policy or government could avoid being punished.

From a research on the relationship between population density and streets in cities, I find that denser cities have less street space per person. The amount of street space does not increase as fast as population density, so dense areas have higher levels of congestion. The continuously increasing off-street parking makes traffic congestion worse because most of them have minimum parking requirements. One of their suggestions is suitable for Beijing's new city zone, which is removing off-street parking requirements, or converting them from minimums to maximums.

However, the aforementioned parking problems in Beijing may not all apply to my study area.

Data collection and Methodology:

In the study area, there are many private parking spaces. Since private parking spaces won't affect the supply and the demand of parking in the area. Therefor private parking spaces are not presented in my study. Although, the existing of private parking spaces still have some impact on the overall parking situation in the area. Apart from private parking spaces, another category of parking lots will not be presented either. They are inside parking lots. Inside parking lots are parking lots that owned by government departments, institutions, state own enterprises, and schools. Those parking lots are for staff only. Therefore they don't affect the overall of supply and demand also.

I will find out the parking price of the study area. However, there are variety types of parking facilities in the study area. According to the Beijing municipality, in the study area, parking facilities are divided into the following categories. 1. Street Parking. 2 Open Air Parking Lots. 3. Other Types of Parking Facilities. Parking rates are different among different parking facilities, and among different time periods. Table-1 shows parking rates for different parking facilities in different time periods.

	Day Time (7:00 - 21:00)				Night Time (21:00-7:00)		
Type of Parking Lots	Street Parking		Open Air Parking Lots	Other Types	Street Parking	Open Air Parking Lots	Other Types
Temporary Parking Parice	1st. Hour	Next	2.5/15Min	2/15Min	Free	1/2H	
	2.5/15Min	3.75/15Min					
Monthly Parking Price	150/Month, 1600/Year						

Table-1

From the table, we can see that there are two operating time periods, day time and night time. Day time is defined as from 7AM to 9PM. And Night time is defined as from 9PM to 7AM next day. The monthly parking permit is 150 Yuan per month and the annual parking permit is 1600 Yuan per year. Other types of parking lots include underground parking garages, and all other parking structures. During day time, street parking has two rates. Within the first hour, the rate is 2.5 Yuan per 15 minutes, after first hour, the rate goes up to 3.75 Yuan per 15 minutes. Open air parking lots' rate is 2.5 Yuan per 15 minutes constant and other types of parking lots' rate is 2 Yuan per 15 minutes. During night time, street parking is free in the study area. Open air parking lots and other types of parking lots have a same rate of 1 Yuan for every 2 hours.

Since I hypothesize the overall parking rate is underpriced in the study area, so I need to prove that. I choose to use usage rate of parking spaces to determine whether the rate of parking is underpriced in the study area. If the usage rate is too high, it indicates that the parking rate is underpriced. If the usage rate is too low, it indicates that the parking rate is too high. The usage rate of parking spaces is equal to number of legally parked cars ÷ number of parking spaces × 100%.

To find out the usage rate of parking spaces, I decide to do following steps.

1. In a certain time period, and in a certain area, count the total number of legally parked cars.

2. Count the total number of parking spaces in the certain area.
3. Calculate the usage rate of parking spaces by using number of legally parked of cars ÷ number of parking spaces × 100%.

Legally parking is defined as cars that parked on legal parking spaces. However, in the study area, there are two categories of legal parking spaces. One is registered parking spaces. It means parking spaces that under municipal operating or leased out by municipality. The other category is unregistered parking spaces, which are parking spaces that not under municipal operating. But people are allowed to park on them. And most of them located in Hutong.

The only way to get the accurate number of parking spaces is to visit the study area and count them manually. This is because we cannot obtain the information of unregistered parking spaces, so we don't know the number of unregistered parking spaces.

To determine the degree of parking law enforcement in the study area, I decide to quantify it by checking the percentage of illegal parking in the study area. The percentage of illegal parking is equal to number of illegally parked cars ÷ total number of parked cars × 100%.

To find out the percentage of illegal parking, I decide to do following steps.

1. In a certain time period, and in a certain area, count the total number of illegally parked cars.
2. Count the total number of parked cars in that time period and the certain area.
3. Calculate the percentage of illegal parking by using number of illegally parked cars ÷ total number of parked cars × 100%.

Illegal parking is defined as cars that not parked on registered parking spaces or on unregistered parking spaces. Illegal parking could be car parked on sidewalks, bike lanes, or any type of none-parking zones. Picture 1 shows an illegal parking on sidewalk.

I decide to visit the study area 4 times a week, 3 times on weekdays and 1 time on weekend. For each time, I'm going to pick several blocks randomly in the study area as a certain area that I mentioned before. In a certain area, I will collect the number of illegally parked cars, number of parking spaces, and number of legally parked cars. Since parking price is different during day time and during night time, so for each time I visit, I will both collect data during day time and during night time. This process will last totally three weeks during my stay in Beijing.

Picture 1: An illegal Parking on Sidewalk (Photo by Long Chen)

Observation Results:

After three weeks, site observation confirmed my guess that this is the only way to collect data. Since online information is missing, and too many parking spaces are unregistered. So the only way get accurate information is to do site observation. Apart from curb-side parking spaces, there are totally 4 registered parking facilities in the study area. 2 of them are owned by municipality (affiliated companies owned by Beijing Government). Others are owned by private companies. Among these 4 parking facilities, three of them are open air parking lots. The other one is underground parking garage. These four parking facilities totally provide 246 parking spaces. And plus the 101 curb-side parking spaces, the study area totally has 347 parking spaces. However, this is not the totally number of parking spaces in the area. As I mentioned in the study description above, people park somewhere in Hutongs and won't get tickets. I put them in legal parking spaces. According to my observation, the total number of parking spaces in the area should be 454, which means 107 of the total 454 parking spaces are unregistered, or 25%. Following table listed my observation results.

Weekday Day Time	Dec. 30th. 2013 Monday 9AM-11AM	Dec. 31st. 2013 Tuesday 9AM-11AM	Jan. 6th. 2014 Monday 3PM-5PM	Jan. 8th. 2014 Wednesday 1PM-3PM	Jan. 9th. 2014 Thursday 4PM-6PM	Jan. 10th. 2014 Friday 5PM-7PM	Jan. 14th. 2014 Tuesday 10AM-12PM	Jan. 15th. 2014 Wednesday 10AM-12PM	Jan. 16th. 2014 Thursday 10AM-12PM	Total
Number of Parking Spaces Observed	168	321	286	347	340	208	332	239	301	2533
Number of Parking Spaces Used	144	256	255	312	313	196	262	206	268	2211
Usage Rate	86%	82%	89%	90%	92%	94%	79%	86%	89%	87%
Number of Illegal Parking	32	89	82	54	47	32	46	52	51	485
Percentage of Illegal Parking	18%	26%	24%	15%	13%	14%	15%	20%	16%	18%

Table 2 Observation Results on Weekday during Day Time

Week Night	Dec. 30th. 2013 9PM-11PM	Dec. 31st. 2013 9PM-11PM	Jan. 6th. 2014 10PM-12PM	Jan. 8th. 2014 10PM-12AM	Jan. 9th. 2014 9PM-11PM	Jan. 10th. 2014 9PM-11PM	Jan. 14th. 2014 9PM-11PM	Jan. 15th. 2014 10PM-12AM	Jan. 16th. 2014 10PM-12AM	Total
Number of Parking Spaces Observed	168	321	286	347	340	208	332	239	301	2533
Number of Parking Spaces Used	111	196	146	146	235	123	203	108	132	1398
Usage Rate	66%	61%	51%	42%	69%	59%	61%	45%	44%	55%
Number of Illegal Parking	20	26	23	14	30	13	21	25	22	194
Percentage of Illegal Parking	15%	12%	14%	9%	11%	10%	9%	19%	14%	12%

Table 3 Observation Results on Weekday during Night Time

Weekend	Dec. 28th. 2013 Saturday 9AM-11AM	Jan. 4th. 2014 Saturday 9AM-11AM	Jan. 11th. 2014 Saturday 9AM-11AM	Total
Number of Parking Spaces Observed	287	302	258	847
Number of Parking Spaces Used	279	297	241	817
Usage Rate	97%	98%	93%	96%
Number of Illegal Parking	49	55	49	153
Percentage of Illegal Parking	15%	16%	17%	16%

Table 4 Observation Results on Weekend during Day Time

Weekend Night	Dec. 28th. 2013 Saturday 9PM-11PM	Jan. 4th. 2014 Saturday 9PM-11PM	Jan. 11th. 2014 Saturday 9PM-11PM	Total
Number of Parking Spaces Observed	287	302	258	847
Number of Parking Spaces Used	166	199	165	531
Usage Rate	58%	66%	64%	63%
Number of Illegal Parking	32	38	41	111
Percentage of Illegal Parking	16%	16%	20%	17%

Table 5 Observation Results on Weekend during Night Time

Table 2 shows the observation results on weekday during day time. Table 3 shows the observation results on weekday during night time. Table 4 shows observation results on weekend during day time. And Table 5 shows observation results on weekend during night time. For an example, on January 4th 2014, which is a Saturday, I went to the area and observed totally 302 parking spaces. And 297 were occupied. So the usage rate is 98%. And during the observation period, I saw 55 illegal parking. There for the percentage of illegal parking is 16%. Figure 1 shows the overall usage rate of parking spaces in the study area. During weekday daytime, the usage rate of parking spaces is 87%. During weekday night, the usage rate of parking spaces is 55%. During weekend daytime, the usage rage of parking spaces goes up to 96%. And During weekend night, the usage rage of parking spaces is 63%. Figure 1 shows the usage rate of parking spaces in different time period.

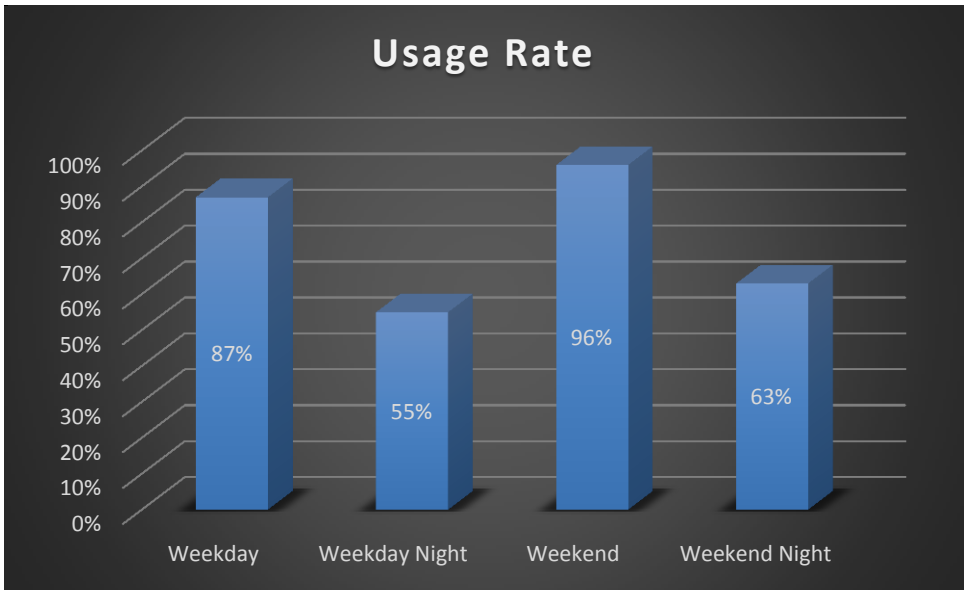


Figure 1: Usage Rate of Parking Spaces in Different Time

Picture 2 shows a regular open air parking lot in the study area, and picture 3 shows the information board of the parking lot. For registered parking spaces, I can easily get the information from an information board nearby. It lists the operation time, parking rate, number of parking spaces, etc.

Picture 2: An Open Air Parking Lot (Photo by Long Chen)

Picture 3: Information Board

However, for unregistered parking spaces, I have to manually count the number of parking spaces. Picture 4 shows some unregistered parking spaces. Most of those spaces are located in Hutong. People can legally park for free.

Picture 4: Unregistered Parking Spaces

Although the overall usage rate of parking facilities is very high in the study area, but the distribution is uneven. Uneven distribution effect could be seen both on time periods and on locations.

In the northern part of the area, usage rate is extremely high. No matter on weekdays or on weekends, you can hardly find an empty space (during daytime). Whereas in the southern part of the area, thought the usage rate is also very high (about 80% in South, and 90% in North), but you can still find some empty spaces. The reason for this situation is that historical tourist sites are located on the northern part of the area. While in the south, residential buildings are located in the south. And the 2nd Ring Road is on the north edge of the area, so most of drivers are entering from north. That is also the reason why traffic congestion always happen on roads from north to south direction. Figure 2 shows the usage rate uneven distribution effect on locations.

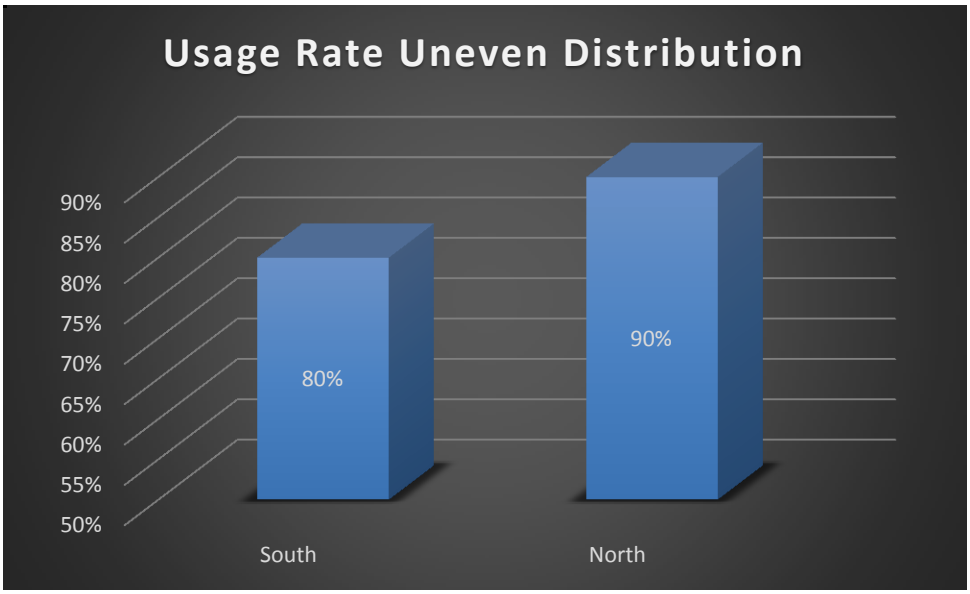


Figure 2: Usage Rate Uneven Distribution on Locations

Uneven distribution effect could also be seen on different time periods. Table 6 shows the observation results on weekday in the morning. And Table 7 shows the observation results on weekday in the afternoon.

Weekday Day Time	Dec. 30th. 2013 Monday 9AM-11AM	Dec. 31st. 2013 Tuesday 9AM-11AM	Jan. 14th. 2014 Tuesday 10AM-12PM	Jan. 15th. 2014 Wednesday 10AM-12PM	Jan. 16th. 2014 Thursday 10AM-12PM	Morning Total
Number of Parking Spaces Observed	168	321	332	239	301	1361
Number of Parking Spaces Used	144	256	262	206	268	1136
Usage Rate	86%	82%	79%	86%	89%	83%
Number of Illegal Parking	32	89	46	52	51	270
Percentage of Illegal Parking	18%	26%	15%	20%	16%	19%

Table 6 Observation Results on Weekday in the Morning

Weekday Day Time	Jan. 6th. 2014 Monday 3PM-5PM	Jan. 8th. 2014 Wednesday 1PM-3PM	Jan. 9th. 2014 Thursday 4PM-6PM	Jan. 10th. 2014 Friday 5PM-7PM	Afternoon Total
Number of Parking Spaces Observed	286	347	340	208	1181
Number of Parking Spaces Used	255	312	313	196	1075
Usage Rate	89%	90%	92%	94%	91%
Number of Illegal Parking	82	54	47	32	215
Percentage of Illegal Parking	24%	15%	13%	14%	17%

Table 7 Observation Results on Weekday in the Afternoon

The overall usage rate of parking spaces in the area is 87% on weekday during day time. But according to my observation, among different time period, the usage rate of parking spaces is different. Figure 3 shows that on weekday during day time, the usage rate is 83% in the morning. And the usage rate goes up to 91% in the afternoon.

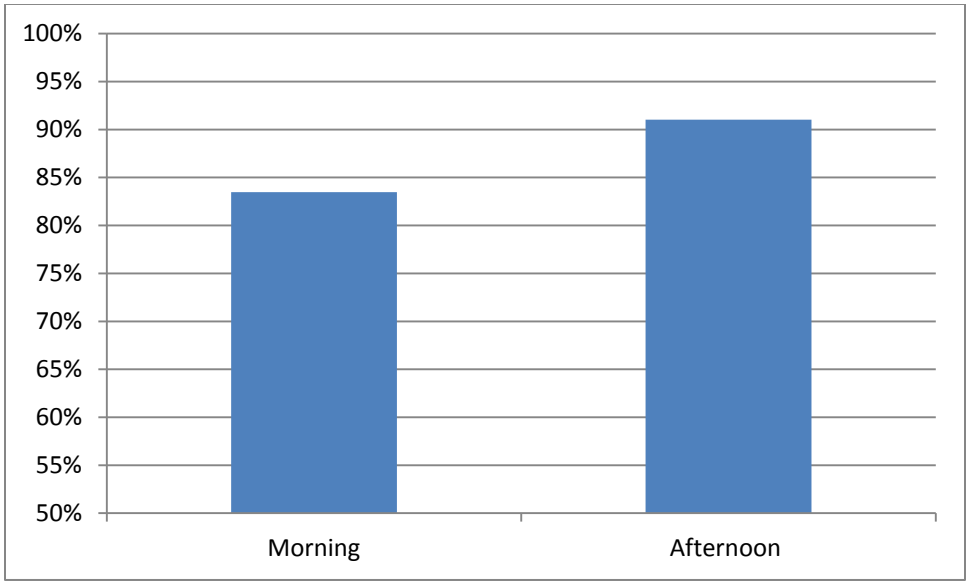


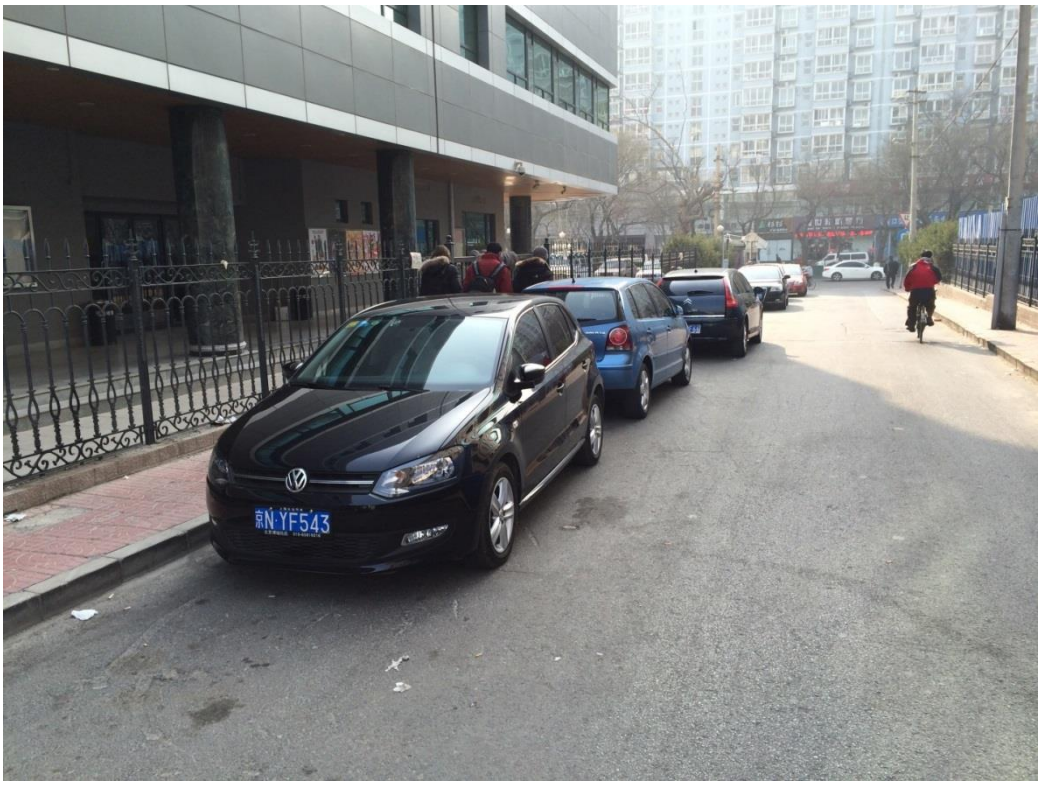
Figure 3 Usage Rate Uneven Distribution on Time Periods

And, the uneven distribution effect on time periods is also significant on weekday during night time. The observation results show that observation during 9PM – 11PM, the average usage rate is more than 60%. And observation during 10PM – 12AM, the average usage rate is 50%. The usage rate of parking spaces drops significantly after 10PM. But from observation results, I don't see any uneven distribution effect on weekend.

Observation results show that the overall illegal parking rate in the study area is 18% during weekday's daytime, 12% at night. And 16% during weekend's daytime, 17% at night. Figure 4 shows the percentage of illegal parking in the study area among different time periods.

Figure 4: Percentage of Illegal Parking

Illegal parking also has an uneven distribution effect in the area. Illegal parking rate is higher in two particular spots than in the rest of the area. One is nearby those historical tourist sites. And the other is nearby a hospital. Although I don't have accurate data to support my point of view, but according to my observation, these two spots contribute a lot of illegal parking in the study area. Picture 5 shows some illegal parking on streets nearby a hospital. There are only 52 parking spaces available to public nearby the hospital, which could not meet the huge demand for hospital parking. That's why this spot has a very high illegal parking rate. Picture 6 shows some illegal parking nearby a historical tourist site. People park on street for their own convenience.



Picture 5: Illegal Parking nearby a Hospital (Photo by Long Chen)

Picture 6: Illegal Parking nearby a Historical Tourist Site (Photo by Long Chen)

Major Problems and Possible Solutions:

Mispricing is the fundamental cause of parking problem in the study area.

First, observation result shows that the monthly/annual parking permit is not applied to the study area. All parking facilities in the study area are not allowing drivers to use monthly/annual parking permit. So the monthly/annual parking permit doesn't affect supply and demand of parking spaces at all.

The investigation result shows that on weekdays, the usage rage of parking lot is 87% in daytime. And the rate goes up to 96% on weekends. This indicates that parking spaces are underpriced. The low pricing gives people incentives to drive to the area and led to a series of traffic problems. It could increase traffic congestion; led to a shortage of parking spaces; increase the cruising time of finding a parking space; etc. Besides, in the study area, 24.6% of parking spaces are unregistered, and they are free for parking. This indicates that the actual price of parking is even lower. However, the conclusion doesn't apply to night time. This is because the 55% of usage rate of parking spaces on weekday's night and 63% of usage rate of parking spaces on weekend's night imply price is reasonable during night time.

Raise parking price is imperative. However, I can't suggest how much should be increased, because that is a more technical question. Although, higher parking price could results to a lower usage rate of parking facilities. But, it could increase the overall revenue from parking, which makes more efficient use of parking facilities.

The mispricing is not only reflected on pricing itself, but also reflected on other factors. Firstly, the outdated pricing. The existing pricing standard was established in 2011, and has not been changed since that time. However, the number of cars increased 500,000 from 4.9 million to 5.4 million from 2011 to now. And the annual economy growth rate is over 9.1% from 2011 to now (People's Daily, 2014). So only these two statistics could indicate that the current pricing standard is outdated. And the relevant department does not have a flexible and advanced pricing mechanism. Parking price should follow the market. Market is the best way to adjust price. Taking Chicago as an example, after Chicago parking privatization in 2009, parking price skyrocketed to 6 times than before. And the previous parking price had not been raised for 12 years (NPR, 2013). However, according to the market, parking price in Chicago has continued raised 50 cents for every year or every two years. So, a reasonable pricing system and a timely pricing adjustment system could also increase the efficient use of parking facilities.

Next, unreasonable pricing mechanism. The existing parking price standard set a uniform standard within the 3rd Ring Road in Beijing. Wherever within the 3rd Ring Road, parking prices are the same. However, the standard is unreasonable. There are many neighborhoods within the 3rd Ring Road, and each neighborhood has different demand for parking. For instances, the study area is a historical tourist site. It attracts a lot of tourists. However around the Southwestern 3rd Ring Road, low-income residences and city villagers are main component. And the CBD is located on the Eastern 3rd Ring Road. But they all follow the same parking price standard. This is unreasonable. Policy maker are too cursory when creating the standard. I suggest that the existing parking pricing standard should be revised. And policy makers should create a more reasonable pricing mechanism. Since different neighborhoods have different demand for parking, price should be specifically divided. Even in a same neighborhood, parking has different demand

on different street. Taking my study area as an example, many historical sites are located on the north part of the study area. So the demand for parking in the north part of the area is higher than in the south. That's why parking lots located in the north part of the area are always full. So, policy makers should create a more reasonable parking price mechanism and create a more detailed parking price standard.

Lack of monitoring and lack of law enforcement is the root cause of high illegal parking rate.

If we contrast between the Figure 1 and the Figure 4 again, we can see the percentage of illegal parking through different time period doesn't change a lot. During night time, when usage rate of parking spaces is low, which means availability of parking spaces is good. And parking price during night time is reasonable. So, both availability and price do not have any significant impact on illegal parking. Therefore it indicates that the availability of parking spaces and parking price do not affect percentage of illegal parking. So people choose to park illegally.

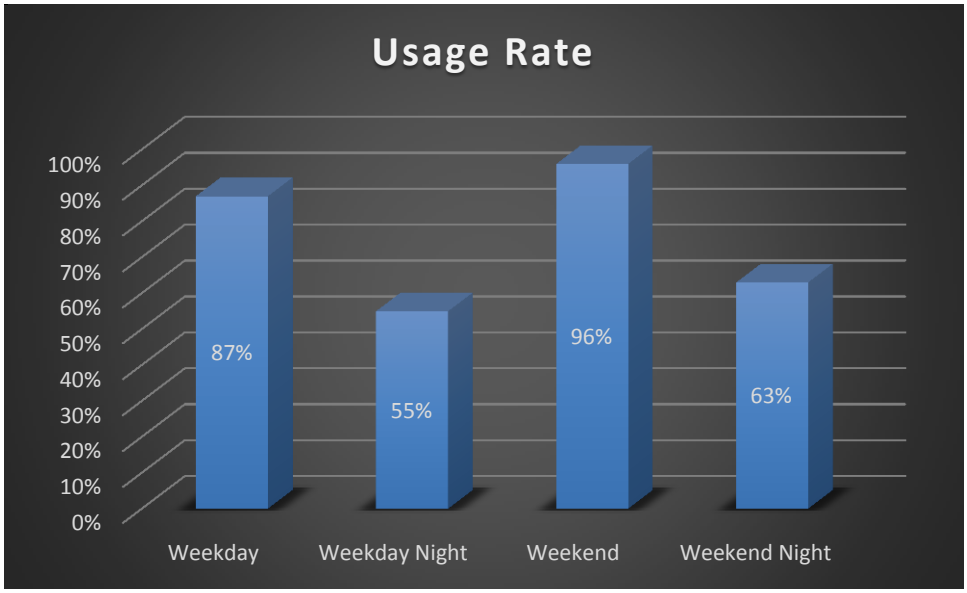


Figure 1: Usage Rate of Parking Spaces in Different Time

Figure 4: Percentage of Illegal Parking

Although, illegal parking rate is high, but parking tickets are barely seen in the study area. Picture 7 shows a parking ticket on an illegal parked car. Within the area, there are four major boulevards and several Hutongs. Illegal parking was barely observed on major boulevards. On the Contrary, countless illegal parking were observed in Hutongs.

Picture 7: Parking Ticket (Photo by Long Chen)

Why illegal parking in Hutong won't get tickets? Based on my observation, ticketing people are usually patrolling on major roads. They seldom get into Hutong. That's one of reasons why parking tickets were never seen in Hutong. Nevertheless, as law enforcer, ticketing people should have known the parking situation in Hutong. But why illegal parking in Hutong doesn't get punishment? Picture 8 shows some illegal parkings in non-parking zone in Hutong. This make me think that local residents' parking behavior. Since people won't get punishment when parking in Hutong, it seems that local residents have reached a community agreement that it is allowed to park anywhere in Hutong. The strong autonomous in Hutong keeps law enforcement power away from it.

Picture 8: Illegal Parking in None-Parking Zone in Hutong (Photo by Long Chen)

Apart from illegal parking, non-drivers' behaviors were observed. Non-drivers' behavior also prove the lack of law enforcement in the study area.

Shop and small business are very common commercial forms in the study area. Boutique stores, bars, and cafes, etc. are seeing everywhere in the study area. And this area is also an emerging cultural and creative industries gathering places. Shop and small businesses owners in Hutong usually park their car in front of their stores. If spaces in front of their stores are sidewalk or non-parking zone, they just illegally park there. And if spaces are public parking lot, they usually illegally occupied it and not allowed social vehicles to park there. Picture 9 shows a typical type

of illegal parking in Hutong. Shop owner illegally parks his/her car in front of his/her shop. If ticketing people showing up, the shop owner will always stop them.

Illegal occupying of parking spaces is also a common problem in the study area, especially in Hutong. Local residets may put some barriers on parking spaces to prevent other people from using them. Picture 10 shows that parking spaces are illegally occupied by local residents.

Picture 9: Illegal Parking in front of a Shop (Photo by Long Chen)

Picture 10: Two Parking Spaces are Illegally Occupied by Hutong Resident (Photo by Long Chen)

Therefore, the Lack of monitoring and law enforcement could be one of main reasons of high illegal parking rate in the area. Causes have multiple reasons. Like regulatory issue, institutional problems, and planning mistakes. However, particular in this case, I suggest government should strengthen law enforcement and let regulation work.

People who are elastic to parking, like visitors, strengthening law enforcement could raise their opportunity cost of illegal parking. However, for people who are in elastic to parking, like Hutong residents, they have to park anyhow. And since they have already reached a community agreement, force them to leave non-parking zones in Hutong is not a good solution. The municipality and planners show reregulate the management mechanism.

Besides aforementioned two major problems, a minor problem could be commercial vehicle parking. In Beijing, there is no concept of commercial vehicle only. Loading trucks park on the regular parking spaces. The study area has many retailers and restaurants. However, this is may not be one of the major problems in the study area. Since the *Beijing Road Transport Regulations* forbid any types of trucks to enter 6th Ring Road from 6AM to 12AM (Unless for those of trucks that holding special permit). So, most of loading/unloading works are done late at night and early in the morning. But, distributers usually use vans to do delivery during daytime. This further deteriorates the situation of lacking of parking space. So the Beijing government could either strictly enforcing regulations (forbid any types of commercial vehicle parking during daytime) or implement some more detailed regulations, like regulating commercial parking during daytime.

Picture 11: A Commercial Truck in front of a Restaurant Unloading (Photo by Long Chen)

Alternatives

Apart from driving to this area, there are many alternatives.

Taxi is the most convenient way. Assume that we depart from Fengtai Railway Station (the farthest distance from the study area within 4th Ring Road) and taking taxi to the area. The distance is about 18 Kilometers. And the one way price is about 55 Yuan (Assuming no traffic or light traffic). If people park for 8 hours in the area, price will be 115 Yuan.

However, taxi is not suitable for everyone. For visitors who do not speak Chinese mandarin will have difficulty in communicating with taxi drivers. And for short time visitors, taxi is still very expensive.

Subway is a good alternative for everyone. Beijing has the cheapest subway rate among Chinese cities, a flat rate of 2 Yuan per ride. And there are clear signs written in both Chinese and English and maps in every station.

There are 3 subway stations serve the area (reference). Two subway stations on Line 2 and one on Line 5 serve the area. Anywhere in the region are within the walking distance of these three subway stations. Line 2 is the second subway line in Beijing, which runs under the 2nd Ring Road. And line 5 runs through the city from outside the North 5th Ring Road to outside South 3rd Ring Road, carrying most of the passengers in eastern part of the city. And both of these two lines have multiple transfer stations that connect many subway lines.

Another alternative is bus. There are totally 6 bus lines serve the area (reference). Rate of bus is 1 Yuan and if people have a Beijing buses IC card (most of long-term residences have) the rate will be 0.4 Yuan. Although it is very cheap by taking buses, but buses may not be a good choice. 4 out of these 6 lines are local lines. The main function of these four lines is to transport local people. They connect places within the old inner city. And local people seldom contribute to parking congestion in the area.

Discussion on the Upcoming New Policy:

Beijing city government has long been aware of the parking problems. In early November 2013, the Beijing Municipal Commission of Transport announced a new parking management regulation, and it will be put into practice in this year. The new regulation provides some solutions for Beijing's parking problems. However, these policies have two sides, some are good and some are bad. And some of them are not suitable for Beijing Old City and not suitable for the study area. Here, I'm going to add some comment on the new regulation.

The city encourages society participating in parking lots' construction, and encourages social units to open their staff parking lots. In Beijing old city, there are some government institutions' buildings and city own enterprises, and public schools. They are not open on weekends. However, they could provide a substantial number of parking spaces. They all have inside parking lots that not open to public. The new policy encourages them to open their parking lots to public for relieving parking spaces shortage, and as an alternative way to generate municipal revenue. Now, during weekends, they are close and not allow social vehicles to use their parking lots. If they open their parking lots, it will be a full use of social resources. However, does it apply to the study area? I'll put a question mark here. Since the study area has a lot of tourist sites and attracts many visitors especially on weekends. So on weekends, traffic is very heavy in the area. If these institutions open their parking lots to public, which means give people more incentives to drive to the area. That will further burden the traffic in the area. Picture 12 shows a research institution's inside parking lot.

Picture 12: A Government Institution' Inside Parking Lot (Photo by Long Chen)

The City government would like to introduce time-restricted curb-side parking. Allow residential curb-side parking with time restrictions. In the study area, curb-side parking has no time restrictions now. Drivers can park no matter how long they want. Some people park on curb-side whole day for their own convenience. However, this could be a waste of public resource. If time-restricted curb-side parking implemented, parking spaces could be provide to people who really need it. Furthermore, if time-restricted implemented, there will be a substantial increase in parking price. The city could generate more revenue from curb-side parking. This ordinance is suitable for the study area because tourist sites attract short time visitors (Reference).

The city encourages multi-story parking structures in the old city; encourages building new parking lots in the immediate proximity of the parking-limited area; encourage constructing underground parking lots. The existing minimum parking requirement (established in 1994) regulates that within the 3rd Ring Road, every 10 dwelling unit should be allocated 3 parking spaces (Reference). However, the new regulation increases the ratio from 1:0.3 to 1:1, which means the city needs to construct more parking spaces. All of these aforementioned ordinances are aiming at increase parking spaces. But increase parking spaces could not fundamentally solve the problem. On the contrary, the government's emphasis on accommodating more parking spaces could result to some negative results. Increase parking spaces could give people more incentive to drive. And further increase traffic congestion.

Removing illegal parking spaces and strengthening law enforcement. In the study area, illegal parking is a serious problem. And lack of law enforcement is the root cause of parking issue. However, the new regulation doesn't clearly state how to strengthen law enforcement and how to deal with the existing problems. Here are some suggestions: Firstly, city government should clarify the responsibility and let public now what department is responsible for ticketing. City government should put ticketing people either under traffic policy department or establish an independent department who in charges ticketing. However, only strengthening law enforcement still cannot fundamentally solve the problem. The fundamentally solution should be considered from the perspective of urban planning and the height of urban planning.

Conclusion and Further Considerations:

Parking planning should be a component of transportation planning. Before creating a parking plan, the city should determine the city's overall transportation planning development strategy first. After determined the overall transportation planning, the relevant department should figure out the parking supply and demand system, and make a guide policy. And then, in each specific area, planners ought to know the layout of both on-ground and underground spatial structures, and manage and plan for an entire area. And planners should also work out how to coordinate parking facilities with city transportation hub, and public transportation stations (subway stations, bus stations). Finally, planners should work with construction team to clear the time sequence of parking lots construction for avoiding unnecessary demolishing and rebuilding. Being specific in the study area, it is impossible to rebuild or relocate parking facilities. Some adjustments could help. Since parking is uneven distributed in the study area, and parking lots are always full in the north part of the area. Signage could be installed on crossings and exits of major roads.

Currently, traffic management department is responsible for managing the city's parking system. However, planning for parking should not only be responsible to traffic management department. The city traffic management department shall, jointly with other administrative departments, like department of urban planning, to work out parking solutions for Beijing together. And planning for parking should base on a city's overall urban planning strategy and the comprehensive transportation planning, combined with the development needs of urban construction and traffic/pedestrian safety.

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